



National University of Engineering (UNI)
School of Civil Engineering
Syllabus 2026-II

1. COURSE

CE3H5. Introduction to Fluvial Hydraulics (Mandatory)

2. GENERAL INFORMATION

2.1 Course	: CE3H5. Introduction to Fluvial Hydraulics
2.2 Semester	: 10 th Semester.
2.3 Credits	: 4
2.4 Hours	: 2 HT; 4 HP;
2.5 Duration of the period	: 16 weeks
2.6 Type of course	: Mandatory
2.7 Learning modality	: Face to face
2.8 Prerequisites	: CE3H1. Fluid Mechanics II. (8 th Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

Introduction to Fluvial Hydraulics covers the behavior of natural channels under the action of flow and sediment transport: from basin erosion and sediment properties, through the calculation of bed load, suspended load, and total load, to the analysis of scour and fluvial morphology using tools such as the Lane balance. The course culminates with the design of channel stabilization and bank protection works, reservoir sedimentation management, and an introduction to river navigation.

5. GOALS

- Analyze bed load, suspended load, and total sediment transport in alluvial channels.
- Calculate general and local scour, and analyze the morphology and stability of river channels.
- Design channel stabilization works and bank protection structures.
- Evaluate reservoir sedimentation and the fundamentals of river navigation.

6. COMPETENCES

ABET-1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (Usage)

ABET-2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. (Usage)

7. TOPICS

Unit 1: Introduction to Fluvial Hydraulics (2 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Scope and objectives of the Fluvial Hydraulics course.	• Describe the scope of river engineering and its role in water resources engineering [Familiarizarse].
Readings : [Jul10]	

Unit 2: Sediment Transport in Alluvial Channels (22 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Watershed erosion and sediment yield • Physical properties of sediment: size, shape, density, and fall velocity • Flow in sand and gravel channels and associated bed-forms • Flow resistance in alluvial channels • Incipient motion condition and design of erodible channels • Fundamentals and techniques for measuring sediment transport • Bed load sediment transport • Suspended load sediment transport • Sediment entry into intakes and diversion structures • Total sediment load transport formulas	• Explain watershed erosion processes and their relation to sediment yield [Familiarity] • Classify sediments by their physical properties and estimate their fall velocity [Usage] • Determine the incipient motion condition for a given alluvial channel [Assessment] • Calculate flow resistance in an alluvial channel accounting for bedforms [Usage] • Estimate bed load and suspended load transport rates using standard formulas [Assessment] • Apply total sediment load formulas to an alluvial channel design problem [Usage] • Evaluate sediment entry into an intake and propose exclusion measures [Assessment]
Readings : [Jul10], [Gar08]	

Unit 3: Open Channel Flow and River Mechanics (8 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Channel flow classification and hydraulic elements • Energy and momentum principles in open channels • Uniform flow and Manning's equation • Critical flow and specific energy concepts • Gradually varied flow profiles • Hydraulic jump and rapidly varied flow • Channel design for stable conveyance • Sediment transport in open channels • River morphology and channel stability • Scour analysis and protection measures	• Classify open channel flow regimes and calculate hydraulic elements [Familiarity] • Apply energy and momentum equations to solve channel flow problems [Assessment] • Calculate normal depth and discharge using Manning's equation [Usage] • Determine critical depth and analyze specific energy relationships [Assessment] • Compute gradually varied flow profiles using standard methods [Usage] • Analyze hydraulic jumps and calculate energy dissipation [Assessment] • Design stable channels with appropriate cross-sections and linings [Usage] • Estimate sediment transport rates in alluvial channels [Assessment] • Evaluate river channel stability and bank erosion potential [Familiarity] • Predict scour depths at hydraulic structures and design protection [Assessment]
Readings : [Cho59]	

Unit 4: Design of Hydraulic Structures (2 hours)	
Competences Expected: ABET-2	
Topics	Learning Outcomes
• Dam types and selection criteria • Spillway hydraulics and design • Weir and gate flow equations • Energy dissipation and stilling basin design • Culvert hydraulics and design • Dam safety analysis and risk assessment • Outlet works and control structures • Fish passage facilities and environmental hydraulics • Cavitation analysis and prevention • Physical hydraulic modeling and scale effects	• Classify dam types and select appropriate configurations for site conditions [Familiarity] • Design spillways for flood discharge capacity [Assessment] • Calculate discharge over weirs and through gates [Usage] • Proportion energy dissipation structures and stilling basins [Assessment] • Analyze culvert hydraulics for inlet and outlet control [Usage] • Perform dam safety evaluations and hazard classification [Assessment] • Design outlet works including intake structures and conduits [Usage] • Incorporate fish passage requirements in hydraulic structure design [Assessment] • Evaluate cavitation potential and design preventive measures [Usage] • Interpret physical model results and apply scale corrections [Assessment]
Readings : [Nov+07]	

Unit 5: Scour and Fluvial Morphology (26 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Scour fundamentals and long-term bed elevation changes • Computation of general scour • Local scour from contractions, bends, and confluences • Local scour at bridge piers and abutments • Fluvial morphology cycles and processes • Shape, geometry, and stability of alluvial channels • Lane balance: qualitative channel response and modeling • Interaction between highway infrastructure and natural streams	• Calculate the general scour depth in a channel reach [Assessment] • Determine local scour from contraction and at bridge piers and abutments [Usage] • Analyze long-term bed elevation changes in a fluvial reach [Assessment] • Describe the cycles and processes governing alluvial channel morphology [Familiarity] • Apply the Lane balance to predict the qualitative response of a channel to changes in its variables [Usage] • Evaluate interaction problems between highway infrastructure and natural streams [Assessment]
Readings : [Gar08], [Jul10]	

Unit 6: River Engineering (24 hours)	
Competences Expected: ABET-2	
Topics	Learning Outcomes
• Channel stabilization: design criteria and examples • Control structures for riverbank protection • Design of riprap, gabions, and protective filters • Practical design considerations for river protection works • Reservoir sedimentation and dead storage volume • Trap efficiency and management of reservoir sedimentation • Analytical fundamentals of river navigation • River navigation paradigms and port conditioning	• Design a channel stabilization structure for a given reach [Usage] • Select and size bank protection structures (riprap, gabions, filters) [Assessment] • Apply practical design considerations to a conceptual river protection case [Usage] • Estimate the dead storage volume and useful life of a reservoir due to sedimentation [Assessment] • Evaluate the sediment trap efficiency of a reservoir and propose management measures [Usage] • Explain the analytical fundamentals of river navigation and its port conditioning [Familiarity]
Readings : [Gar08]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

***** EVALUATION MISSING *****

10. BASIC BIBLIOGRAPHY

- [Cho59] Ven Te Chow. *Open-Channel Hydraulics*. McGraw-Hill, 1959.
- [Nov+07] Pavel Novak et al. *Hydraulic Structures*. 4th. Taylor & Francis, 2007.
- [Gar08] Marcelo H. García. *Sedimentation Engineering: Processes, Measurements, Modeling, and Practice*. ASCE Manuals and Reports on Engineering Practice No. 110, 2008.
- [Jul10] Pierre Y. Julien. *Erosion and Sedimentation*. 2nd. Cambridge University Press, 2010.